THE ENGINEERING CONFERENCE.

THE fourth engineering conference of the Institution of Civil Engineers commenced on the morning of Wednesday, June 19, when an opening address was delivered by Sir Alexander B. W. Kennedy, F.R.S., the president of the institution. In the course of his remarks, the president referred to the essential catholicity of the aims of the institution. All and every department of industrial activity which can possibly be covered by the name engineering fell within the ken and interest of the institution. In spite of the very extended ground covered by the subjects of the sections, members of the Institution of Civil Engineers alone had been invited to take part. It was not necessary to go beyond the borders of the institution to find men, not only interested, but distinguished, in every department of engineering. The president emphasised the unity rather than the diversity of their work, and expressed the hope that members would not confine their interest and presence to those sections only with the business of which their every-day work was concerned. In conclusion, the president explained that the papers to be read were notes, intended merely to open and stimulate discussion.

The members then separated into the various sections. The discussions occupied the morning of Wednesday, Thursday, and Friday. The limitations of space permit of brief notices only of the more important matters dealt with.

Section I., Railways. Chairman, Mr. W. R. Galbraith.

A discussion on the chemical composition of steel rails was opened by Mr. C. P. Sandberg, who described the effects of phosphorus, sulphur, manganese, silicon, and carbon. Mr. W. Willox stated that certain rails on the Metropolitan Railway had worn out in five months only; the Sandberg rail, he thought, would reduce the trouble considerably. In this type of rail the silicon is added in the form of silico-spiegel or ferro-silicon, which gives better results than silicon left in the steel from pig-iron during the conversion.

The subject of reinforced concrete for railway structures was introduced by Dr. C. A. Harrison. Evidence was sought of the ability of this form of construction to resist the fatigue and stress of railway traffic, and also as to whether the metal reinforcement is not liable to corrosion. Mr. W. Bell gave information regarding a building in ferro-concrete erected under his supervision for the North-Eastern Railway. He considered this building to be satisfactory, and found that, in places where it had been necessary to cut the concrete, the metal bars were clean and bright.

The use of a bituminous preparation in preference to paint wherever possible was advocated by Mr. B. Blount as being the best means of preserving iron and steel work. Mr. H. R. A. Mallock, F.R.S., contributed a note on the action between the wheel and the rail, in which he calculated from theoretical grounds that the wear on rails having a two-minute service for twelve hours a day would amount to 2·6 inches per year, a result which might be altogether avoided by somewhat increasing the tread.

Mr. W. Dawson described a system of audible signalling which has been experimented on by the Great Western Railway. The danger signal is given to the driver by means of a small steam whistle fixed to the cab of the engine, actuated by a fixed bar bolted to the sleepers. The fixed bar is electrified when it is desired to give the "all right" signal, and then has the effect of ringing a bell on the engine. Colonel Yorke expressed the importance attached by the Board of Trade to such apparatus, but stated that his department would insist on absolute trustworthiness before sanctioning its use.

In speaking on light-railway policy, Sir A. B. W. Kennedy thought that, in view of the development of motor traction, light railways had nearly reached their termination in this country, excepting in special cases.

Section II., Harbours, Docks, and Canals. Chairman, Sir William Matthews, K.C.M.G.

Lord Pirrie contributed a paper on harbour and dock requirements as affected by the development of shipping. In his opinion, finality in the size of ships had not yet been reached. The desire for greater economy and also passengers' wishes for greater comfort and luxury would lead to further developments. Owing, however, to existing conditions as regards dock accommodation and depth of channels, shipbuilders had been forced into increasing the length rather than the breadth or draught.

Ferro-concrete and reinforced concrete structures were also discussed in this section. Mr. C. S. Meik gave evidence of the strength and durability of the ferro-concrete pier at Purfleet on the Thames. Questions of dock equipment, dredging, and electric and hydraulic power for working dock machinery were dealt with. Mr. W. W. Squire considered that the tendency towards the extended use of electric appliances was on the increase.

Section III., Machinery. Chairman, Prof. W. C. Unwin, F.R.S.

The business of this section opened with a valuable and interesting discussion on the relative merits of turbines as applied to marine propulsion and of reciprocating engines. The principal point raised was the relative coal and steam consumptions. The Hon. C. A. Parsons stated that in war vessels the consumption has now been brought to substantially the same figure as with reciprocating engines, and that in pleasure steamers the turbine now showed an efficiency 5 per cent. to 15 per cent. superior to similar vessels having triple-expansion reciprocating engines. Sir Wm. White and Sir John Durston contributed to the discussion. Mr. Gerald Stoney referred to the great efficiency of the low-pressure steam turbine, and quoted instances of the successful application on land of such turbines working with the exhaust steam discharged from reciprocating engines, which steam would otherwise be wasted owing to the inability of reciprocating engines to deal economically with steam at very low pressures. Mr. Parsons was of the opinion that future development for slow-speed vessels such as cargo steamers would be in the direction of a combination of reciprocating engines for the high-pressure part of the expansion and of turbines to deal with the low-pressure part. He estimated that such an arrangement would show an improvement in coal consumption of about 12 per cent. over quadruple-expansion reciprocating engines, and from 15 per cent. to 20 per cent. over the best triple-expansion engines.

Other subjects discussed in this section were precision grinding, machine-tool design as affected by the use of high-speed cutting tools, the use of pneumatic tools, reciprocating air-compressors, and turbo-compressors for high pressures. The last subject was introduced by Prof. A. Rateau, of Paris, who described his recent work in the development of turbo-compressors. He specially directed attention to one of his machines (which consists essentially of a reversed steam turbine) placed in the mines at Bethune, which compresses the air to 6 and even 7 atmospheres, and has the further interesting feature of being driven by a steam turbine utilising the exhaust steam from one of the winding engines. The efficiency of turbo-compressors is about of the same order as piston compressors. Turbo-compressors have the advantages of simplicity of parts and the capability of being directly connected to high-speed motors.

Section IV., Mining and Metallurgy. Chairman, Mr. John Strain.

This section opened with a discussion on problems of the Witwatersrand goldfields, introduced by Mr. G. A. Denny. Questions of labour difficulties and machinery were dealt with. Shaft-sinking and shafts for deep winding were also discussed. Recent applications of the Poetsch freezing method of shaft sinking in the Durham coalfield were described by Mr. H. Louis. Arrangements of colliery surface works were described by Mr. E. M. Hann. Mr. J. E. Stead, F.R.S., introduced the subject of segregation in steel, and illustrated his remarks by reference to etched specimens. The causes of segregation and its effect on the mechanical properties were fully dealt with. Mr. B. Blount contributed a paper on electro-metallurgy, dealing with the present state of the industry and the possibilities of its application to the manufacture of steel. The subject of the education of students of mining and metallurgy was introduced by Mr. W. Rowley, who described the methods adopted in the West Riding of Yorkshire. Mr. Rowley severely criticised the present Government examination for certificates of competency, an examination which, he said, could be passed by men who have not that acquaintance with scientific principles which is desirable. The papers have often been so stereotyped that correspondence and other methods of cramming only are needed to enable a man to pass. The composition of the board of examiners had often been characterised by conspicuous absence of men qualified by scientific training and knowledge to examine candidates, however eminent might be their position in particular branches of the mining profession. Mr. Rowley emphasised his opinion that a solid foundation of a broad and liberal education was essential to the student prior to his course in applied science.

Section V., Shipbuilding. Chairman, Dr. F. Elgar, F.R.S.

A joint discussion with Section II. on harbour and dock requirements opened the work of this section. A very important discussion on the uses of high-tensile steel was opened by three papers contributed by Mr. A. E. Seaton, Mr. A. F. Yarrow, and Mr. E. W. De Rusett. High-tensile steel for structural work may be described as steel having an ultimate tensile strength of about 40 tons per square inch. In the Forth Bridge such steel was used in compression only; Mr. Seaton was of the opinion that to-day there need be no hesitation in using it under tension. By use of this material it is possible to reduce largely the weight of a given structure. Recently the huge Cunard ships have been constructed so as to withstand the heavy expected stresses by the free use of the high-tensile steel of Spencer and Colville. Mr. Yarrow quoted the present Admiralty practice of steel of 37 tons to 43 tons per square inch with specified minimum elongations in 8 inches. In his own practice a considerable reduction of dead weight had been effected by the use of high-tensile steel. Mr. E. W. De Rusett gave information as to the use of high-tensile steel in the construction of the *Mauretania*. By instruction of the authorities of Lloyd's Registry, rivets of mild ingot steel were adopted. The rivet holes in plates less than ½ inch thick were punched ⅛ inch under size and rimered out. This method was found not to interfere with the strength of the joints. Rivet holes in plates more than ½ inch thick were drilled. Sir Wm. White recommended for the proper use of high-tensile steel (*a*) thorough testing in the makers' works; (*b*) proper treatment of the material (as regards heating, &c.) in the shipbuilders' yards; (*c*) structural arrangements suitable for the new material. He was of the opinion that both mild steel and high-tensile steel can be successfully used in the same structure. Rivets of quality agreeing with the material of the plates should be employed, and such was the practice of the Admiralty. Sir P. Watts said that high-tensile steel rivets were at present used successfully in the Service. Mr. Colville gave the results of the experience of the Steel Co. of Scotland on the manufacture of high-tensile steel. Mr. Ritchie, of Parkhead Forge, quoted the case of a steam boiler of high-tensile steel working at 500 lb. per square inch pressure. Mr. Thearle, of Lloyd's, spoke of the necessity for avoiding improper heat treatment of high-tensile steel rivets. Other subjects dealt with in this section were structural details of cargo steamers, arrangements for working cargo, high-speed vessels, modern applications of superheating, and the welding of structural materials in place. In the last, methods of electric welding, welding by the oxy-hydrogen and oxyacetylene flames, and welding by the use of thermit were discussed.

Section VI., Waterworks, Sewerage, and Gasworks. Chairman, Sir George Thomas Livesey.

The first paper read in this section was on the comparative cost of pumping by steam, internal combustion engines, and electricity, based on actual working. The authors, Messrs. Charles Hawksley and Henry Davey, made out a strong case in favour of direct pumping by steam engines. Speakers in the discussion disagreed with certain figures given in the paper. Thus the authors give 1 lb. of oil per B.H.P. generally for oil engines, but the Diesel oil engine has a guaranteed consumption of 0·4 lb. of oil per B.H.P.; 1·75 lb. of coal per B.H.P. for gas engines is stated in the paper to be the engine-maker's estimate, but 1·25 lb. would be nearer. Electric current could also be obtained at a cheaper rate than that given, viz. ½*d.* per unit.

Papers on water softening and water hardening were contributed by Messrs. W. Matthews and J. Watson respectively. Softening is of value in many cases where the water is too hard to be available for supply, and the process also gives a means of defence against bacteria. The working in practice of various systems of water softening was discussed. The practice of hardening water for domestic purposes is intended to counteract acidity and neutralise peaty water possessed of lead-dissolving properties.

Applications of towns' gas as a heating agent were described in a paper by Mr. W. H. Y. Webber. The author referred to the practice now generally adopted by gas engineers of speaking of their product in terms of its calorific value rather than of its illuminating power. The domestic uses of gas for heating purposes were dealt with, and the author expressed his opinion that producer gas did not make headway against town gas at 2*s.* per 1000 cubic feet.

The distribution of gas at increased pressure was introduced by Mr. C. C. Carpenter, who described the present practice of the South Metropolitan Gas Company in using non-positive blowers giving an initial pressure of about 20 inches of water. Gas engines are preferred for driving the blowers as being more convenient. This company has 1200 miles of pipes, and finds that the unaccounted gas amounts to 4½ per cent. only.

Mr. J. D. Watson contributed a paper on sewage disposal by biological processes, in which he gave the results of the methods adopted at Birmingham, where sewage purification is effected by mechanical precipitation and septic treatment.

The relative merits of chemically treated, settled, and septic sewage in preparing the liquid for oxidising beds formed the subject of a paper by Mr. G. A. Hart. The author has compiled facts obtained from observations made on the sewage of Leeds during the last nine years. The most effective chemical precipitant was found to be a combination of 6 to 8 grains of lime and 2 grains of aluminium sulphate per gallon of sewage. Settlement is employed sufficient to reduce the suspended solids in crude sewage to an average of about 8 grains per gallon. Dealing with septic fermentation, the author stated that at a twenty-four hours' rate of flow about 30 per cent. of the suspended solids were digested in the tanks, 31 per cent. passed out with the effluent, and the balance of 39 per cent. remained as deposit.

Section VII., Applications of Electricity. Chairman, Colonel R. E. B. Crompton, C.B.

The first paper taken was on electrical transmission gears on motor vehicles, by Mr. A. A. C. Swinton. The author directed attention to the crude methods of gear changing used in petrol-driven motor vehicles, and gave short descriptions of several arrangements of electrical transmission which have been adopted. Mr. Hart gave the results of his experiments using continuous current machinery, which he had discarded in favour of polyphase alternating current. He had now an omnibus running in which the consumption of petrol amounted to one gallon per 6½ miles, the electric machinery being used for starting only, giving a smooth and rapid acceleration. Mr. W. H. Stevens advocated the use of continuous current. Mr. Swinton referred to the question of the weight of the petrol-electric equipment, which is greater than that of purely petrol machinery.

The subject of electric working of railway points and signals was opened by Mr. Ferreira, who enumerated the principal conditions considered essential in modern signalling, and discussed the various electric methods adopted for complying with these conditions.

Papers on upkeep charges on large electric generating sets and on modern applications of electricity to mines were contributed by Messrs. Burstall, Highfield and Sparks. In the last paper the application of the high-lift centrifugal pump in combination with the electric motor was mentioned as showing a great advance on previous methods of pumping.

On the evening before the formal opening of the conference, the James Forrest lecture, on "Unsolved Problems in the Design and Propulsion of Ships," was delivered by Dr. Francis Elgar, F.R.S.

During the conference the members had the privilege of visiting many works and generating stations, and these opportunities were taken advantage of to a large extent. The institution conversazione was held on Thursday evening in the Albert Hall, when a large and representative gathering met for social intercourse.

THE ROYAL SOCIETY CONVERSAZIONE.

MOST of the exhibits of scientific interest at the Royal Society on June 19, on the occasion of the soiree to which ladies as well as gentlemen are invited, were shown at the conversazione on May 8, and have been described already in NATURE (May 16, p. 57). It will be sufficient, therefore, to refer briefly to exhibits not mentioned in the previous article.

Lantern and other demonstrations were given during the evening by Prof. H. A. Miers, Prof. Flinders Petrie, and Mr. Louis Brennan. Prof. Miers showed experiments illustrating the growth of crystals in drops of solution, and indicating that the latter are of two sorts. If a solution be sufficiently strong, crystallisation may be started spontaneously by mere shaking or friction. In such a solution the crystals are apt to grow rapidly in the form of delicate needles and fronds. If the solution be supersaturated, but not strong enough to give birth to crystals in this way, they can only grow if introduced from without (by "inoculation" of the drop), and are apt to grow in symmetrical forms. A solution, as it cools, passes quite suddenly from the one state to the other. Prof. Petrie lectured on houses in ancient Egypt, and Mr. Brennan again showed and described his working model of the Brennan mono-railway.

The subjoined descriptions of the exhibits have been abridged from the official catalogue:—

Mr. A. A. Campbell Swinton: Vacuum tube phenomena. (1) Exhibition of the mechanical effects of kanal rays in causing the rotation of mill-wheels in Crookes tubes. These rays, which are positive, travel in the opposite direction to the negative rays that proceed from the kathode. They can be detected both when they are approaching the kathode, and also, if the latter is perforated, after they have passed through the apertures. (2) Photomicrographs of the bubbles that are developed by sudden heating of portions of the glass walls of Crookes tubes, owing to the occlusion by the glass of the residual gas during prolonged use. (3) Exhibition in the microscope of a special case of the above, in which the sudden heating was occasioned by an electric spark, which has thus impressed its own image on to the glass. The image is entirely made up of minute bubbles, and from its form it is clear that the spark was a positive one.—*Mr. C. E. S. Phillips:* (1) A fibre electroscope. In this electroscope the gold leaf is replaced by a fibre of electrically conductive glass which is delicately hinged so as to move very readily under the influence of a difference of potential. (2) An electroscope charger. The ease with which celluloid may be electrified by friction, together with its poor insulating property, are made use of in this apparatus. A celluloid rod is rubbed at one end by a flannel-lined split brass tube. The charge so produced slowly spreads to the opposite extremity of the rod and is there utilised. Either a positive or negative charge may be obtained with the same instrument. (3) Electrically conductive glass. The composition of this glass is as follows:—sodium silicate, thirty-two parts; borax, eight parts; Powell's flint glass, 1·25 parts. The electrical conductivity is about 500 times as great as that of any other glass, and this material is suitable for the windows of electrostatic instruments as well as for supplying the fibres used in the fibre electroscope.—*Mr. J. Mackenzie Davidson:* Stereoscopic X-ray photographs in a revolving lenticular stereoscope. A single X-ray photograph is a central projection shadow of the object placed between the Crookes tube and the photographic plate, and cannot therefore correctly indicate the real relative position of the parts—but *stereoscopic* X-ray photographs at once give a combined image which shows correctly their relative size and position. This could be observed in the series of transparencies exhibited.—*Mr. A. Kershaw:* A new visual method of measuring the speeds of photographic shutters. This consists principally of a variable-speed revolving disc with radial slits, in conjunction with a stationary illuminated slit.—*Mr. Edward Whymper:* Photographs taken in the Rocky Mountains of Canada and in the Alps.

Mr. William Burton: Pilkington's Lancastrian lustre pottery. The examples illustrate the perfecting of the old lustre process of decoration. By this method metallic vapours of silver and of copper can be driven into pottery glazes at a very low red heat under the influence of reducing gases. The surface of the metallic film so obtained glows with brilliant iridescent colours. The process has been reduced to such precision that the kilns are hermetically sealed during the firing, and no "trials" of any description are drawn from start to finish of the process. The temperature is recorded by the use of two thermocouples, placed at the bottom and top of the kiln respectively. The reducing gases are of standard composition, so that the process is so far as possible automatic.—*Hon. C. A. Parsons, F.R.S.:* Photographs of diamonds obtained from pure iron heated in a carbon crucible in an electric furnace and rapidly cooled. Scale, 150 diameters.—*Dr. Herbert Smith:* Precious stones, cut and uncut. The exhibit includes most of the mineral species that are available for jewellery purposes. The following are the more noteworthy of the specimens:—a star-twin of diamond; crystals and faceted specimens of olivine (peridot) from the Red Sea; sapphires from Montana and Ceylon; natural and "reconstructed" rubies; various opals, including opalised shells; diamonds, chrysoberyls, and topazes from Rhodesia; garnets from German East Africa; and specimens of the rare species phenakite, axinite, and diopside.—*Dr. Tempest Anderson:* Photographs illustrative of the volcanoes of Central America, and of a revisit to the Soufrière of St. Vincent. The volcanoes of the Soufrière of St. Vincent and Montagne Pelée in Martinique, both to the east of the Caribbean Sea, erupted in 1902. The volcano of Santa Maria in Guatemala, to the west of the same sea, erupted in the same year, and when it was examined this spring the eruption proves to have been of the same character.

The Royal Society: The Linnæus bicentenary—original certificate of candidature of Linnæus, dated 1753, for election into the Royal Society.—*Dr. W. A. Cunnington and Mr. C. L. Boulenger:* Examples of the fauna of the Fayûm Lake, Birket-Qurun, investigated at the request of the Egyptian Survey Department. (1) Series of the fishes, including examples of the three different kinds of Bulti (Tilapia). The females take charge of the eggs and young, which they seclude in the mouth and gill-chambers. (2) Series of the invertebrates of the lake, including examples of a new lacustrine medusa (*Moerisia lyonsi*).—*Prof. Charles Stewart, F.R.S.:* (1) Specimens illustrating alternation of generation. (2) Various invertebrates and birds showing colours due to structure; mostly thin films, and not pigment; consequently the colour is lost on crushing.—*Prof. S. J. Hickson, F.R.S.:* A collection of species of the genus Corallium, and a specimen of *Corallium maderense*, polished and mounted in silver.—*Dr. Ernst Hartert:* Birds represented in the British Isles by peculiar forms, and their Continental allies. So late as 1892 Wallace accepted only three birds as peculiar to the British Isles ("Island Life," p. 340), and even more recent works have not mentioned more than three or four. Careful investigations, however, have shown that about twenty British birds show constant and often easily recognised differences from their Continental allies. Eighteen of these are exhibited, with their allies, in order to show their differences.

Prof. Flinders Petrie, F.R.S.: Pottery soul-houses, 3000 B.C. These models, made by the Egyptians, were found at the cemetery of Rifeh in Upper Egypt, where they had been placed upon the graves. They were developed from the trays of offerings for the dead, to which a shelter was added, and further enlarged with the addition of furniture so as completely to resemble an actual house, in which the soul was supposed to dwell. Their period is from the ninth to the twelfth dynasty. Found by the British School of Archæology in Egypt, 1907.